SCIENCE

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THE GROWTH OF CHILDREN.

BY FRANZ BOAS.

DURING the past years a vast number of observations referring to the growth of children have been accumulated. The method of treating the results of such observations has been largely a comparison of averages and of the frequency of occurrence of cases between certain limits, for instance, frequency of occurrence of statures from inch to inch, or of weights from pound to pound.

In discussing the results of such observations, the question arises in how far the results have a physiological meaning and in how far they are purely statistical phenomena. It is generally assumed that the figures express physiological facts.

Serious objections, however, may be raised against this point of view. In almost all cases, excepting observations like those of Wretlund, Malling Hansen, and Carlier, the observations have been taken only once on a great number of individuals, not repeatedly through a long number of years on the same individuals. For this reason the classes, when arranged according to ages, will be differently constituted. The younger classes contain many individuals who will not reach the adult stage, while the older classes contain only few individuals who will die before becoming adults. When we assume that all classes are equally constituted, we assume implicitly that the value of the measurement under consideration has no fixed relation to the mortality, which assumption seems to be very doubtful. Without considering details, it would appear very likely that individuals far remote from the average, showing either too small or too large measurements, approach the limits between physiological and pathological variation, and are therefore more likely to die. This would imply a greater variability of the measurements of deceased individuals of a certain age than of the living individuals of the same age. The series of living individuals of all ages can be equally constituted only when the measurements of the living and the deceased show the same values. This fact has already been pointed out by H. Westergaard ("Grundzüge der Theorie der Statistik," p. 188).

We have a few observations which seem to make the identity of the series of measurements of the living and of the deceased individuals of the same age very improbable. The most important among these is the peculiar decrease in the brain-weight after the twentieth year in males. This can hardly be explained in any other way than by assuming an increased death rate among men with very large brains at an age of about twenty years.

Bowditch and Roberts have shown that, on the average, children of well-to do parents are taller and heavier than those of poorer parents. Carlier has shown the same phenomenon by proving that a number of children of a certain class when brought under more favorable conditions (i.e., in a military training school) grow more rapidly than the rest who are left in their former conditions. We know that the mortality of children is greater among the poorer classes than among the well-to-do classes. Therefore among the young children a greater percentage belongs to the poorer classes, who are at the same time shorter of stature, than among the older children. This fact expresses itself undoubtedly in the averages of measurements collected in our public schools.

These considerations seem to me sufficiently important to doubt the physiological value of any figures obtained by means of single observations. It does not seem unlikely that the correlation between measurements and mortality is more strongly emphasized at certain periods than at others. If, for instance, many individuals of retarded growth should die during the period of adolescence, this might give the real explanation of the curious overlapping of the curves of growth of girls and boys, the girls being heavier and taller than boys between about the twelfth and fourteenth years. I am strengthened in this opinion by the observation made by Dr. G. M. West, that the extent of this period and the amount of overlapping is the smaller the more favorable the conditions under which the individuals live. It would be interesting in this connection to study the curves of a people which has a very high death rate among young children.

A second point of view which seems to limit the physiological value of the curves relating to growth is the following. I have shown on a former occasion (*Science*, Nos. 483 and 485, 1892) that, owing to the asymmetry of distribution of cases in the years preceding maturity, the average of all observed values cannot be considered the most probable value belonging to the age under consideration. I have also shown that this asymmetry and the increase of variability during the period of adolescence are purely statistical phenomena. Dr. H. P. Bowditch, in his interesting discussion of the growth of children (22d Annual Report of the State Board of Health of Massachusetts, p. 479 ff,), has compared children of the same percentile rank from year to year. He discusses the feasibility of such a proceeding and considers it likely that the same children on the average will remain in the same percentile grade. I believe it can be shown that the children are more likely to vary in rank than to remain stationary in this respect. Any correlation between measurement and mortality must have a disturbing effect. Besides this, we will consider for a moment all those children separately who will, as adults, have a certain percentile rank and investigate their position during the period of rapidly decreasing growth, during adolescence. It seems reasonable to assume that the average individual (not the average of all individuals) will retain its percentile grade throughout life. For instance, the man of the eightieth percentile grade will have belonged to the same grade when a seventeen-year-old boy. At this period a number of these individuals will be in advance of their age, while others will be retarded in growth. It seems likely that the retardation or acceleration is distributed according to the law of probability. As the amount of growth is decreasing rapidly at this period, the number of retarded individuals will have a greater influence upon the average than those of accelerated growth, that is to say, the average of all observed values will be lower than the value belonging to the average boy of seventeen years of age, and as the latter will probably have the same percentile rank throughout life, the average will represent a different percentile rank. We can show in the same way, by comparing the composition of the same percentile grade year after year, that its composition must change. During a period of retarded growth the individuals in advance of their age will be less remote from the percentile rank in question than those whose growth is retarded. Therefore the composition of each percentile grade cannot remain constant.

The interest of a knowledge of the actual anthropometric conditions of children of a certain age shall not be depreciated, but this raw material does not allow us, or at least allows us only in a very imperfect way, to draw inferences of physiological value. In order to enable us to draw these inferences, the material which we make a subject of our study must be in every way homogeneous. This can be accomplished in two ways. A very large number of children may be measured once, and year after year those who die and those whose further fates are unknown must be eliminated from the list. When all have become adults, the survivors and those who died during their first, second, third, etc., years must be treated separately. Furthermore, pains must

presented by the author

be taken to discover if any marked difference exists between the social composition of these groups. While this method may give satisfactory results at a moderate expense, it is far inferior in value to the method of repeated measurements at stated intervals. In this case the same subdivisions must be made, and changes in the social status and in the health of individuals must be recorded and eliminated. In order to carry out such a plan, it would be necessary to organize a bureau with sufficient clerical help to carry on the work. The questions underlying physical and mental growth are of fundamental importance for hygiene aud education, and we hope the time may not be far distant when a work of this character can be undertaken.

SOME ODDITIES IN BIRD-LIFE.

BY C. W. SWALLOW, WILLSBURGH, OREGON.

It is not my intention, in this article, to describe any new species that are unknown to ornithologists, but there are many nature-lovers that cannot identify the birds easily; with such, I hope these descriptions may help and create a stronger desire to know more of the birds.

I will try to describe a few birds that are not as well known to the general observer as the robin, and which, by their rarity or peculiar habits, make them especially interesting to study.

The first species I will notice is Townsend's Solitaire (*Myadestes townsendii*). This is a rare bird to me, as I have never secured but one specimen. It may almost be called a hybrid between the thrushes and flycatchers, yet, by its color and flight, it somewhat resembles the shrikes. These birds are not as large as the robin, being a more slim bird with longer tail. They measure in inches somewhat as follows: Length, 8.5; extent of wings, 13.5; wing, 4.5; tail, 4.25; tarsus, .75. Their bill is about one-half inch long and strongly resembles the flycatchers, being broad and flat and slightly toothed. Bill and feet are black; the back is brownish ash, or slaty; the breast is lighter, shading into light ash on the crissum; top of head brownish black, lighter at base of bill; throat light ash; a light ring about the eye; wings and tail brownish-black; primary wing-feathers slightly edged with white and the secondary wing-feathers and outer tail-feathers quite extensively white-edged, the primaries and secondaries with a spot of yellow or tawny, giving the wing the appearance of having a bold bar of this color at the point of primary coverts; tail forked and slightly double-rounded.

This seems to be the only species of the genus found in the United States. They are probably more common between the Rocky and the Cascade ranges; but stragglers may be found west of the Cascades, even to the Pacific Coast; as I am informed by Mr. R. H. Lawrence that the species has been taken at Astoria. They are reported from New Mexico by A. W. Anthony in the *Auk*. Dr. Coues gives their range as north to British Columbia, stating that they build on or near the ground, laying bluish-white eggs, spotted with brown.

The Bushtits (*Psaltriparus*), although very small, dull-colored birds, are quite interesting and odd, as is also their nest, which is an ingeniously woven, pensile structure that may be found in bushes at the height of one's head, or twenty feet or more up in trees. One that I found last spring was near the end of a long hemlock limb, about twenty feet from the creek over which it hung. It was securely fastened to the small, slender twigs in three places. It was about nine inches long and four and one-half in diameter, outside. It was well and thickly woven, of moss and cottony substance, being strong enough to hold a number of pounds weight. The entrance was a small hole in one side near the top, and the bottom was well lined with feathers. They lay from six to nine small white eggs. These diminutive birds are only about four inches in length, with short, rounded wings less than two inches, and a narrow graduated tail somewhat longer than the wing. They are of a slate color above, shading into ashy on the under parts. They have no bright colors and are not crested. Bill and feet black. These lively little busybodies keep up a continuous twittering as they flit from twig to twig. There are but a few species found in the United States.

Psaltriparus minimus has a brown crown patch, while *P. plumbeus* has a lead-colored crown like the back.

P. lloydi has an ashy crown and black bars on sides of head. This is a southern bird, while the other two may be found as far north as Oregon or Washington.

A DEFINITION OF "SOLUTIONS."[1]

BY C. E. LINEBARGER, CHICAGO, ILL.

Within recent years great progress has been made in our knowledge of solutions. This has been in main due to the application of the laws established for gases to solutions. Solutions are intermediate between liquids and gases. The theory of gases has been well developed, and the next problem is to devise a general theory of liquids. There are two ways of getting at the nature of liquids, — through the critical point and through solutions. Pellat[2] has recently shown the need of precision in the definition of the critical point, and has deduced from a consideration of the iso-thermal curves of carbon dioxide determined by Andrews[3] a definition at once concise and precise. It is my intention in this paper to subject to examination the existing definitions of solutions, and, if they be found inadequate or inaccurate, to propose another. Definitions, the preliminaries of science, are but landmarks of classification. As scientific knowledge advances, the classifications and definitions change: they are provisional and progressive. Until within a few years, our notions of the nature of solutions were so vague that it was not possible to insist upon precise definitions; but now that we have a theory of solutions that rivals the theory of gases in simplicity and even surpasses it in the accuracy of its experimental results, it is time that a suitable definition be adopted.

Among the formal definitions of solutions (which are not very numerous) of acknowledged authorities, I will quote for the sake of comparison the following:—

(*a*) "Auflösung heisst, wenn sich ein fester Körper mit einer Flüssigkeit (einem tropfbar-flüssigen Körper) so verbindet, dass er in dieser Verbindung flüssig wird. . . . Die Flüssigkeit nennt man dann das *Lösungsmittel*, der vorher feste Körper heisst *aufgelöst*, und die neue Verbindung eine *Auflösung*" (Berzelius, Lehrbuch der Chemie, I., 424, fifth edition).

(*b*) "The liquefaction of a solid or gaseous body by contact with a liquid, the solid or gas being diffused uniformly through the liquid and not separating when left at rest" (Watts' Dictionary of Chemistry, article Solutions).

(*c*) "Lösungen sind homogene Gemenge, welche man durch mechanische Mittel nicht in ihre Bestandteile sondern kann" (Ostwald, Lehrbuch der allgemeinen Chemie, I., 606).

In these typical definitions there are three questions that require examination: (1) What is the state of aggregation of solutions? (2) Is homogeneity necessarily a characteristic of solutions alone? (3) What is to be understood by mechanical means, and is it true that solutions cannot be decomposed into their constituents by such means?

As to the first question, it is seen that the two first definitions regard a solution as liquid, which is, indeed, the common conception. Yet undoubtedly solids have the power of dissolving one another under certain conditions, so that a solution may be solid.[4] The expressions "solutions of gases in gases," of "liquids in gases," and even of "solids in gases" are quite general and used by good authorities. Thus the state of aggregation of solutions may be gaseous, liquid, or solid. (See, however, the definition proposed below).

But are there not homogeneous mixtures that are not solutions, no regard being had, however, to mixtures of powders, etc.? Every one knows what solutions of crystalloids, such as sugar or

[1] By solution is understood in this paper the ready-made mixture, no reference being had to its mode of formation; for the action of the solvent upon the substance to be dissolved as well as the product of the action is commonly called a "solution."

[2] De la Definition et de la Determination du Point Critique, Jour. de Phys. (3). I., 225.

[3] Phil. Trans. II. 1869.

[4] Van't Hoff. Zeitschrift für physikalische chemie, 5., 322.